

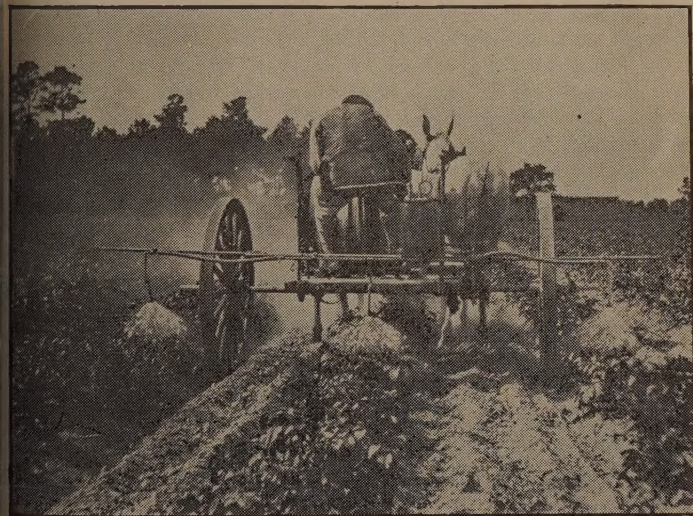
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SPRAYING IRISH POTATOES

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SPRAYING IRISH POTATOES

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During the past eight years experiments have been conducted on the spraying of Irish potatoes by the Division of Entomology of the State Department of Agriculture, in an effort to determine the most practicable and economical spray for both the early and late crop, which would reduce the losses these crops are subjected to by insects and diseases.

To date, spraying experiments have been conducted during six years on the late crops at the Buncombe Station, Swannanoa, N. C.—and during two years on the early crop at three different places in the eastern part of the State. Each experiment consisted of from three to twelve plats treated in different ways, with a few plats left untreated for comparison. In each instance a careful record of the presence, absence, or abundance of insects and diseases was kept, together with a record of the yields, cost of treatment, etc. The cost was then compared with the yield. As a result, we are able to advise potato growers as to the best spray to use on either the fall or spring crop, the number of applications required, when and how to spray, and how to make up the spray mixtures.

EXPERIMENTS WITH LATE CROP (Western N. C.)

Our experiments with the late crop in the western part of the State have shown that the best material to use is the home-made poisoned Bordeaux mixture; this material having yielded the greatest returns during each of the six years it has been used. The poisoned Bordeaux mixture not only successfully controls flea-beetles and Colorado potato beetles, but prevents early and late blight. It is these insects and diseases which decrease the yield of late potatoes when they are not sprayed.

PROFITS FROM SPRAYING THE LATE CROP

A glance at Table I shows the increase in bushels per acre of potatoes sprayed with the home-made poisoned Bordeaux mixture over potatoes which were not sprayed or treated in any way, during 1913 to 1919. It will be seen that in 1913 five sprayings increased the yield 49 bushels per acre. In 1914 five sprayings increased the yield 27 bushels per acre; the yield and increase was low that year because the season was generally unfavorable for growing potatoes. In 1915 three sprayings increased the yield 32 bushels per acre. In 1917 four sprayings increased the yield 104 bushels per acre (see fig. 1); the increase this year was heavy because blight was very abundant and was successfully controlled on the sprayed potatoes. In 1918 four sprayings again increased the yield 53 bushels per acre.

The average increase over the six years was 52 bushels per acre, with a net gain (after the cost of spraying, materials, etc., had been deducted) of \$52.01 per acre.

TABLE I.—GIVING COMPARISON OF YIELDS AND NET GAIN IN VALUE OF AN ACRE OF LATE POTATOES SPRAYED WITH THE POISONED BORDEAUX MIXTURE AND SIMILAR ACRE UNSPRAYED OVER SIX YEAR PERIOD. BUNCOMBE STATION, SWANNANOA, N. C.

Year	Treatment	Yield in Bushels Per Acre	Gain in Bushels Per Acre of Sprayed Over Unsprayed	Net Value Per Acre of Sprayed Over Unsprayed*
1913-----	Sprayed 5 times-----	187	49	\$ 29.58
	Unsprayed-----	138		
1914-----	Sprayed 5 times-----	52	27	25.26
	Unsprayed-----	25		
1915-----	Sprayed 3 times-----	114	32	18.92
	Unsprayed-----	82		
1917-----	Sprayed 4 times-----	218	104	111.71
	Unsprayed-----	114		
1918-----	Sprayed 4 times-----	136	46	50.40
	Unsprayed-----	90		
1919-----	Sprayed 4 times-----	161	53	76.21
	Unsprayed-----	108		
Average, six years-----			52	52.01

*Cost of spraying has been deducted and potatoes valued at current prices at time of digging.

In addition to plats of potatoes on which the poisoned Bordeaux mixture was used, there were also plats on which Bordeaux mixture without poison was used, and other plats where the potato beetles were removed by hand picking.* The experiments show conclusively that the greatest net returns are obtained by spraying with the home-made poisoned Bordeaux mixture.

EXPERIMENTS WITH EARLY CROP (Eastern N. C.)

Spraying experiments with the early crop in the eastern part of the State have not covered as long a period as those with the late crop in the western, but the results of four different experiments over a two-year period indicate that early potatoes make the greatest yield when sprayed with the same home-made poisoned Bordeaux mixture. In these experiments as many as twelve plats have been used. Each plat was treated either with a commercial Bordeaux compound, home-made Bordeaux without and with poison, or dusted with dry poisons such as lead arsenate.

We find by our observations that the chief destructive factor of early potatoes in the east is the Colorado potato beetle, although flea-beetles, plant lice, and early blight are frequently present in destructive numbers.

* The details of these experiments conducted during the years 1913-1918 have been published in Bulletin No. 254, Vol. 40, No. 3, March, 1919, North Carolina Department of Agriculture, which may be had upon application.

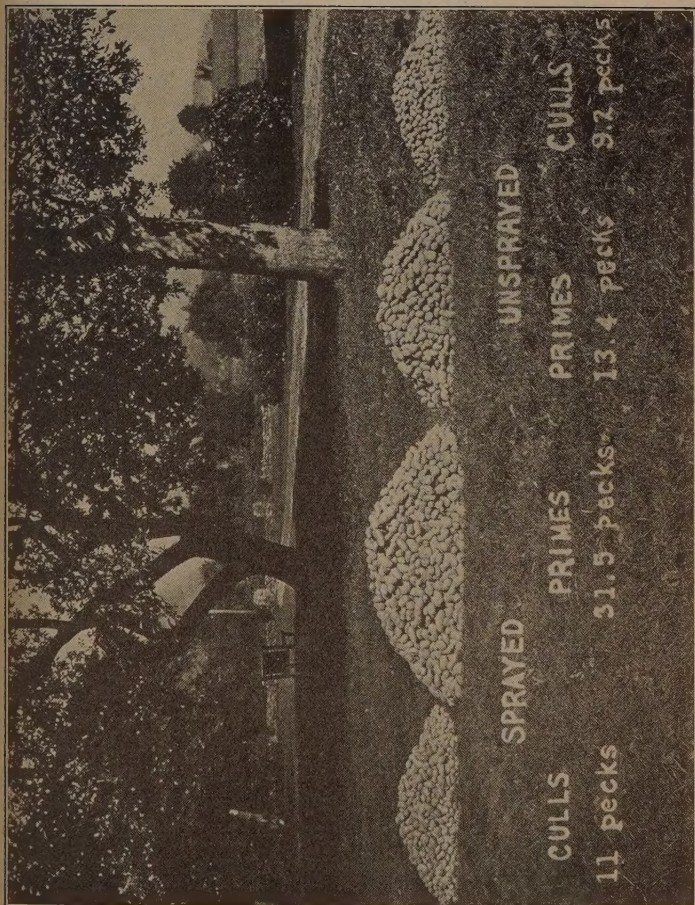


FIG. 1. One-half the yield of two one-tenth acre plats of late potatoes in 1917. One plat, sprayed four times with the Poisoned Bordeaux Mixture, yielded at the rate of 218 bushels per acre; the other, unsprayed, 114 bushels per acre. Swannanoa, N. C.

Potato beetles and flea-beetles are readily controlled by the use of poison alone. However, the combination of Bordeaux mixture and poison would seem to be the safest, as the Bordeaux will then be present to check early blight, should it develop. Moreover, the cost of the spray will be but little more when the poison is combined with the Bordeaux mixture, the cost being readily justified by the general good this mixture does to the vines.

PROFITS FROM SPRAYING THE EARLY CROP

Table II shows that in the experiments at New Bern, in 1918, the potatoes sprayed with the poisoned Bordeaux mixture yielded at the

TABLE II.—GIVING COMPARISON OF YIELDS AND NET GAIN IN VALUE OF AN ACRE OF EARLY POTATOES SPRAYED WITH THE POISONED BORDEAUX MIXTURE AND SIMILAR ACRE UNSPRAYED. FOUR EXPERIMENTS—COASTAL PLAIN SECTION.

Place and Year	Treatment	Yield in Barrels Per Acre*	Gain in Barrels Per Acre of Sprayed Over Unsprayed	Net Value Per Acre of Sprayed Over Unsprayed†
New Bern, 1918.....	Sprayed 3 times.....	35.0	11.5	\$ 41.58
	Unsprayed.....	23.5		
New Bern, 1919.....	Sprayed 3 times.....	82.0	37.0	185.00
	Unsprayed.....	45.0		
Mount Olive, 1919.....	Sprayed 3 times.....	60.0	17.7	88.50
	Unsprayed.....	42.3		
Wilmington, 1919.....	Sprayed 4 times.....	58.3	38.3	332.62
	Unsprayed.....	20.0		
Average, four experiments.....			26.1	161.92

*Two and three-fourths bushels to the barrel.

†Cost of spraying has been deducted and potatoes valued at current prices at time of digging.

rate of 35 barrels per acre, while the unsprayed acre yielded only 23.5 barrels or a gain of 11.5 barrels. The increased value of the sprayed acre, over the unsprayed acre, when the cost of labor and materials for three applications was subtracted, was \$41.58 per acre. In 1919, at New Bern, the sprayed acre yielded 82 barrels and the unsprayed acre 45 barrels, a difference of 37 barrels. The net gain of the sprayed over the unsprayed acre was \$185. At Mount Olive, the same year, potatoes sprayed with the poisoned Bordeaux mixture yielded at the rate of 60 barrels per acre, while the unsprayed acre yielded only 42.3 barrels. The difference here was 17.7 barrels per acre, with a net gain of \$88.50. At Wilmington, in 1919, an acre sprayed with the poisoned Bordeaux mixture yielded 58.3 barrels, and an unsprayed acre yielded 20 barrels (see fig. 2). The sprayed acre, therefore, yielded 38.3 barrels more than the unsprayed acre. These potatoes were sold at a very high market

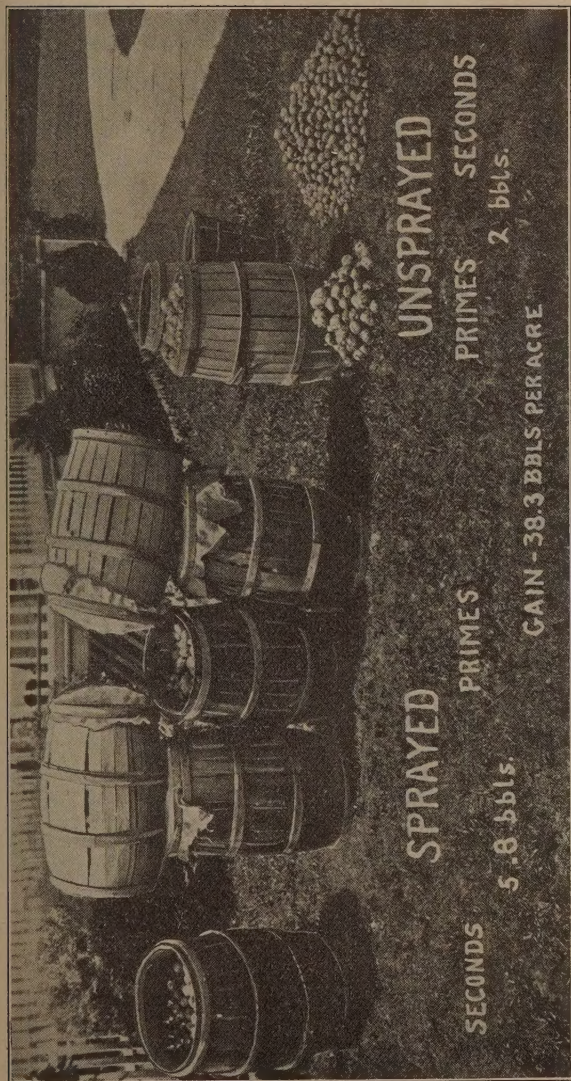


FIG. 2. Yield of two plats on one-tenth acre basis. One plat sprayed with Poisoned Bordeaux Mixture yielded 58.3 barrels per acre. The other plat, unsprayed, yielded at the rate of 20 barrels per acre. The gain of 38.3 barrels by spraying was valued at \$332.62. This experiment was conducted on the farm of J. F. Klein, of Wilmington.

price and the increased value per acre, as a result of spraying, was \$332.62.

If an average of the four experiments be made, we have an increase by spraying, of 26.1 barrels per acre, which were valued at \$161. The losses incurred on the unsprayed potatoes were almost entirely the result of defoliation by potato beetles (fig. 3), which in some instances completely reduced the vines to stems, causing them to die early in the season. Early blight developed very late in the season, but the potatoes were dug for early shipment before the blight had inflicted serious injury.



FIG. 3. Two rows in the foreground were not sprayed and were eaten up by potato beetles. Other rows were sprayed, and produced a good crop of potatoes. New Bern, N. C., 1919.

It is true that these losses could have been reduced greatly by using poison alone, but the Bordeaux mixture in combination with the poison produced results that justified its use. Had early blight developed earlier in the season as it sometimes does, the unsprayed potatoes would have yielded even less.

POISONED BORDEAUX MIXTURE—HOW TO MAKE IT

The ingredients, and amounts of each, for making one barrel (5 gallons) of the poisoned Bordeaux mixture, are as follows:

Bluestone (copper-sulphate, blue vitriol).....	3 pounds.
Stone lime (rock lime, quicklime, unslaked).....	4 pounds.
Arsenate of lead (3 to 4 pounds if paste form is used, or 1½ to 2 pounds of the dry form).	
Water	50 gallons.

Place the bluestone in a cloth sack, or wrap loosely in a piece of cloth, and hang in barrel or keg containing 25 gallons of water. Hang so the bluestone is just covered by the water. This may be easily done by tacking the cloth to the inside of the barrel, or hanging it on a nail inside so that all the bluestone is under water. The bluestone dissolves rather slowly, hence large lumps should be broken. The process of dissolving it can be hastened by using hot or warm water. The bluestone may be hung in the water in the evening in preparation for spraying the next day. This must be in a barrel, keg, tub, or other wooden receptacle.

Place the lumps of lime in barrel or keg and add water to start slaking (hot water will start slaking quicker). Add more water as slaking proceeds, to keep from becoming dry, until, as slaking ceases, the mass is in the condition of a thin, cream-like paste. Add enough water to make 25 gallons.

We now have the 4 pounds of lime in 25 gallons of water in one keg, and the 3 pounds of bluestone dissolved in 25 gallons of water in another keg.*

Pour these two solutions (lime solution and bluestone solution), at the same time, through a wire screen, or other fine strainer, into a full-size barrel and stir thoroughly (see fig. 4).

If less than the whole amount is needed, simply take equal parts of the two solutions, first stirring well and pour them together in a receptacle.

We have not yet put in any poison. Dip out a pailful of the mixture, mix the arsenate of lead carefully in this until it is all reduced to a liquid, then pour back into the barrel and stir.

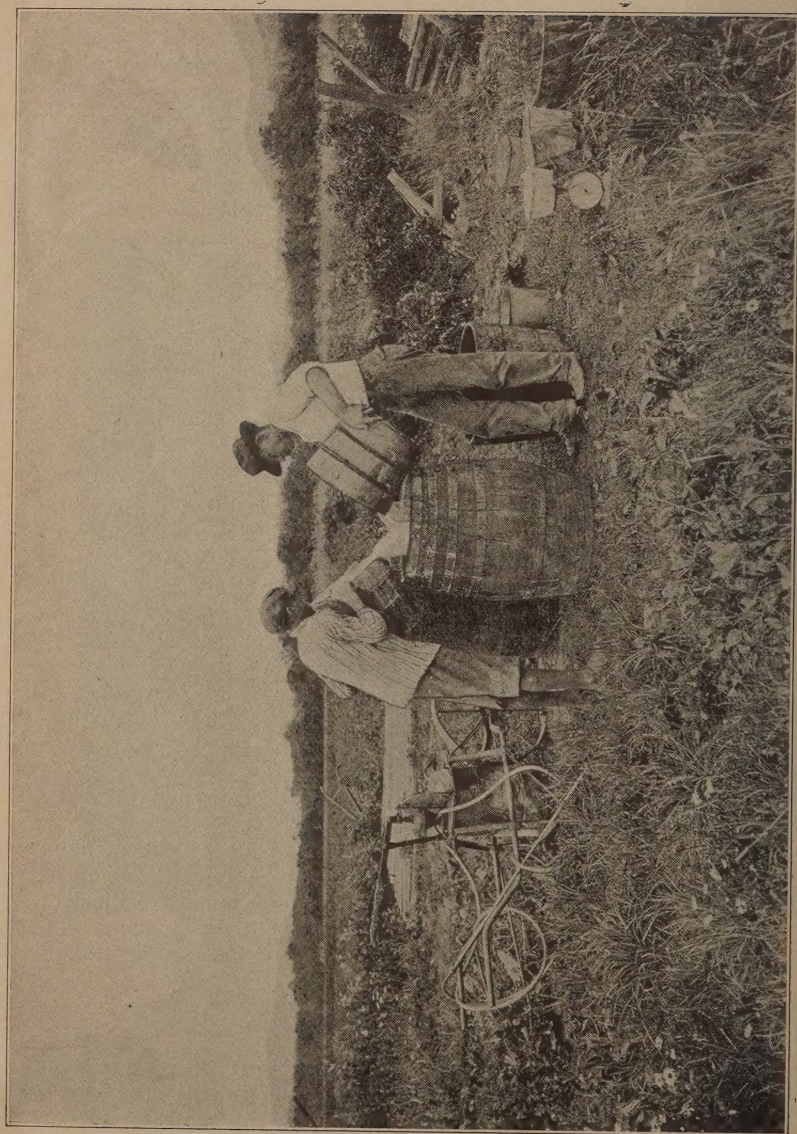
We now have 50 gallons of the mixture containing 3 pounds of bluestone, 4 pounds of lime, and the arsenate of lead.

A stock solution can be made by dissolving 25 pounds of bluestone in 25 gallons of water in one keg and 25 pounds of lime slaked in 25 gallons of water in another keg. When it is desired to make up 50 gallons of the Bordeaux mixture, simply draw off 3 gallons of the bluestone solution and 4 gallons of the lime solution, and add to about 43 gallons of water. Then add the poison as directed above.

HOW TO SPRAY

The object is to thoroughly dampen (slightly wet) all the surface of every leaf. Extreme thoroughness is more important in spraying late potatoes where blight occurs nearly every year. In the case of early

* These two solutions will keep indefinitely if each is kept to itself and properly covered from trash, etc. After they have been combined the mixture should be used the same day.



potatoes, where the potato beetles are the cause of destruction, the spraying need not be so thorough. About 125 gallons per acre should be applied at each treatment.

The spray is usually in the best condition about one to two feet from the nozzle. It should strike the leaves as a fine mist (spray) and the nozzle should be moved about in the case of a hand outfit so that it will not remain more than a "moment" in exactly the same place. It is not intended that any should run off the leaves in streams, nor even to drip very much, but there is bound to be some dripping if the application is thorough as it should be.

A good nonclogging nozzle of the angle type is desirable, as it permits more thorough work and enables the under surface, sides and lower leaves of the plants to be reached to better advantage.

HOW OFTEN TO SPRAY AND WHEN

Experience has shown that late potatoes should be sprayed at least four times during the season, although in some seasons greater comparative returns will be secured from five sprayings. The average dates for four sprayings during the season on the late crop are around May 27, June 13, June 28, and July 18. For five sprayings we would suggest May 27, June 13, June 27, July 11, and July 20. This refers to western North Carolina.

Early potatoes in the east should be sprayed at least three times, or ten or fifteen if potato beetles are numerous and persistent in their destruction. The grower can best determine for himself when to begin spraying, but we would suggest that the first application be made when the first eggs of the season are found hatched.

In general, both early and late potatoes should receive the first application when the plants are from four to seven inches high, or earlier if the beetles appear sooner. Additional applications must be made every ten to fifteen days, depending upon the frequency of the rains and their effect upon the previous spray, and the amount of new growth present. When blight is anticipated, a constant film of spray must be noticeable on the foliage to obtain the best results. The plants should present a bluish-white appearance, only the newest growth showing the clear green untreated leaves.

COST OF SPRAYING

The cost of spraying is very largely an item of labor which may be reduced to a minimum, particularly on large acreages, by using a horse-drawn sprayer (fig. 5). Three applications of the poisoned Bordeaux mixture on early crop potatoes, using a horse-drawn, two-row sprayer in 1918, cost about \$4.33. When potatoes were sprayed twice (up and back on the same rows), the cost increases some, but this "double spraying" is frequently justified on late potatoes if blight is anticipated or present.

PROPRIETARY BORDEAUX COMPOUNDS

There are on the market many ready-made liquid and powdered preparations recommended for use on potatoes. We have had experience with some of these, and in general they may be said to yield satisfactory results. As a rule, however, these compounds, when prepared for use as the labels direct, contain considerably less bluestone per 50 gallons than the 3-4-2-50 formula used in making the home-made poisoned Bordeaux mixture. Hence, if three pounds of bluestone per 50 gallons of mixture are required to control early and late blight, any solution containing 1



FIG. 5. A good type of horse-drawn potato sprayer. It sprays two or four rows at a time. When the plants are large two nozzles are needed to the row for thorough work.

than that amount will not be as satisfactory and may fail completely to control blight. Similarly, if such a solution should contain less than two pounds of dry arsenate of lead per 50 gallons, it would require more frequent applications to obtain results equal to the poisoned Bordeaux mixture which contained two pounds of the poison to each 50 gallons of the mixture. In some instances, then, more bluestone and more poison must be added to the proprietary compound to produce results equal to the poisoned Bordeaux mixture of the 3-4-2-50 formula. The total cost of the proprietary mixture then exceeds greatly that of the home-made mixture. The grower will find it more economical to make and use the home-made poisoned Bordeaux mixture.

DUSTING VERSUS SPRAYING

It is seldom that dusting with a poison is profitable on late potatoes, the potato beetles are as a rule not numerous enough to justify this method of treatment alone. On the other hand, blight is the main factor and can be controlled only by Bordeaux mixture applied as a liquid spray.

On early crop potatoes, dusting with arsenate of lead and powdered lime at the rate of 1 pound arsenate to 6 pounds lime, and calcium arsenate (cal-arsenate) and lime, at the rate of 1 to 8, has been found to produce very satisfactory results when the chief destructive factor is the potato beetle. However, spraying with the poisoned Bordeaux mixture not only controls the beetles, but prevents blight, and in addition seems to stimulate the growth of the vines and keep them healthy. It should be remembered that early blight usually develops on early potatoes about the middle of May, although it has been known to develop earlier, and cause great losses when the potatoes were not sprayed with the poisoned Bordeaux mixture. The safest method calls for spraying with this mixture at least during May and June. Before that time early potatoes may be safely protected from potato beetles by spraying and dusting with the poison.

If no sprayer is available, dusting should be practiced by all means. The dust may be applied with a dust gun or shaken on the plants through a sack. In dusting we would advise dry arsenate of lead thoroughly mixed with air-slaked lime at the rate of 1 pound to 6 pounds of lime; calcium arsenate may be used pure if applied carefully, but it is best applied after mixing with powdered lime or land-plaster at the rate of 1 to 8. Paris green, while a quick-acting poison, is very apt to burn the foliage and should be used very sparingly, and only when arsenate of lead or calcium arsenate cannot be immediately procured.

SUMMARY

Late potatoes (western North Carolina): Spray four or five times with the home-made poisoned Bordeaux mixture containing 3 pounds of kieselguhr, 4 pounds of stone lime, $1\frac{1}{2}$ to 2 pounds of dry arsenate of lead to each 50 gallons of water. This spray will cost about \$8 per acre for four treatments, and will increase the yield over potatoes not sprayed by about 52 bushels per acre.

Early potatoes (eastern North Carolina): Spray three or four times with the home-made poisoned Bordeaux mixture, using formula of preceding paragraph, but add more arsenate of lead if the beetles are numerous and destructive. Omit the Bordeaux mixture and use only the poison, if it is desired, early in the season; but be sure to use it during the months of May and June. It is safest and cheapest in the long run, however, to use the poisoned Bordeaux mixture from the beginning. Three appli-

cations of the poisoned Bordeaux mixture will increase the yield from 12 to 40 barrels (33 to 110 bushels) per acre.

If not equipped for spraying, then dust, using dry lead arsenate and lime (1 to 6) or cal-arsenate and lime (1 to 8) applying by shaking in a sack over the plants while the dew is on them. The pure poison may also be sparingly applied with a dust gun.

Dusting will produce good results when the potato beetle alone is the cause of injury, but it is not a method of insuring the plants against blight, which may develop later in the season. If you are equipped to spray, use the home-made poisoned Bordeaux mixture. It will give the best returns and is the most economical in the long run.

Protect Potatoes from Beetles and Blight



by
making
and
spraying
poisoned
Bordeaux
Mixture



to
secure
the
maximum
yield.

